



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/NO00/00102</p> <p>(22) International Filing Date: 22 March 2000 (22.03.00)</p> <p>(30) Priority Data: 19991608 31 March 1999 (31.03.99) NO</p> <p>(71) Applicant (for all designated States except US): NORSK HYDRO ASA [NO/NO]; N-0240 Oslo (NO).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): RADDUM, Sveinung, Gihle [NO/NO]; Bjerkev. 6, N-2830 Raufoss (NO). ENG, Stein, Morten [NO/NO]; Enerhaugen, N-2847 Kolbu (NO). BROBAK, Tor, Johan [NO/NO]; Feltspatv. 13, N-2830 Raufoss (NO).</p> <p>(74) Agent: RICANEK, Ivan; Norsk Hydro ASA, N-0240 Oslo (NO).</p>		<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>
<p>(54) Title: FASTENING/LOCKING DEVICE</p> <div data-bbox="256 1108 1295 1522"> </div> <p>(57) Abstract</p> <p>Fastening device (2) preventing deflection of pressure die (3) comprises cylinder powered fastening means (15) and stretch bars where the pre-stretched bars act as piston rods. The locking device is especially applicable in hydroforming apparatuses.</p>		

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### "Fastening/locking device"

The present invention relates to an apparatus applicable in hydroforming manufacturing processes and more particularly to a fastening/locking device preventing deflection of two parts tooling (die) applied in the process of hydroforming by means of increased internal pressure.

Different equipment/apparatuses for internal forming of hollow members are known being installed and used for this purpose. Such presently known apparatuses comprise an upper (movable) die part and a lower fixed die to accommodate hollow semiproducs to be subjected to a high (internal) pressure to expand unto the predetermined final configuration of the hollow member. Large presses have traditionally been used in order to prevent deflection of the tooling being under high internal pressure - typically in a range from 500 to 2000 bars...

Drawbacks in common for the known disclosed apparatuses and locking/fastening devices are high investment cost and low operational speed of such large units inhibiting the production performance (speed) and thus the productivity of the hydroforming press units.

Several approaches to resolve these disadvantage are disclosed in recently published patent applications. Thus EP 0 865 845 A1 is believed to disclose the closest prior art to the device according to the present invention, proposes to improve the known constructions by applying parallel distance pieces between the upper and the lower die parts, where the die parts are held together by means of attached membrane configured discs operated by (exposed to) hydraulic and/or mechanic pressure. However, even this construction does not satisfy the request

for a minimum production cycle time resulting in further costs reduction additionally to low investment costs in the hydroforming equipment.

Consequently it is an object of the present invention to provide a novel locking/fastening device applicable in the manufacturing of (hollow) members by means of hydroforming avoiding the above shortcomings known from the presently known/applied apparatuses and particularly substantially reduce the investment costs and the actual production cycle time.

A further object of the present invention is to provide a novel hydroforming apparatus requiring less demanding base foundation and resulting in reduced lead-time of the equipment.

These and other objects of the apparatus according to the present invention are met by provision of the novel locking/fastening device as defined in the attached claim 1 and its preferred embodiments according to dependent claims 2-3.

The invention will now be described in details by means of examples and referring to the attached drawings, Figs. 1-5, where

- Figs. 1, 1a            illustrate schematically in cross-sectional views the novel locking device incorporated in a hydroforming apparatus in a locked position,
- Fig. 2                shows in a detailed cross-sectional view parts of the fastening/-locking device according to the present invention,
- Figs. 3, 4 and 5     illustrate schematically the process steps of positioning of the clamp(ing) device, pressure setting and pressure release of the equipment, respectively.

Figure 1 illustrates schematically in a cross-sectional horizontal view a hydro-forming apparatus comprising a supporting frame 1 accommodating a movable/-retractable frame 9 extending horizontally and perpendicularly to the supporting frame 1. The retractable frame 9 movable sidewise, shown in Figure 1a as a schematical cross-sectional view taken along line A-A in Figure 1, is equipped with one pressurized die 3 having a loading/unloading arrangement allowing for simultaneous feeding/hydroforming or hydroforming/removing, respectively. This arrangement facilitates the manufacturing operation and reduces the time for feeding of blanks 10 into the die hydroforming and finally removal of the (semi)products 12.

As shown in Figure 2, the novel fastening/locking device applying a conventional hydraulic cylinder system comprises tooling plates 2 accommodating the die (halves) 3 being interconnected by means of stretch bars 4. The stretch bars 4 extend horizontally through the assembled die halves 3 into the hydraulic cylinder houses 5 conventionally provided with a set of valves 7 for pressurizing and depressurizing (release of the pressure) of the die assembly, respectively.

The novel and inventive feature of the present fastening/locking device is based on prestretching of the stretch bars 4, the bars acting simultaneously as piston rods for pistons 6 in the cylinder system by special locking means 15.

The construction/configuration of the locking means 15 based on the wedging principle can be seen more clearly in Figure 3 illustrating positioning/assembling of locking means, here shown as a split cotter comprising two parts 15', 15" co-operating with the complementary configured head 41 of the stretch bar 4.

Figure 4 illustrates the working principle of the locking device after pressurizing of the assembly. One of the valves 7 (inlet) is open increasing the pressure inside the cylinder transferring the cylinder house/piston 6 towards the tooling plates 2' and thus pulling the whole clamp arrangement against the opposite tooling plate 2"

via/through the stretch bars 4. This pulling action consequently forces the two die halves 3 together closing the die for the hydroforming operation.

The applied cylinder is designed for a very short stroke (action), typically in a range of about 2-10 mm, something ensuring a very short closing and pressure setting time, thus reducing considerably the whole cycle time.

Figure 5 illustrates schematically the depressurizing step of the cycle reversing the above described tightening/pulling operation by moving the piston house/piston in the opposite direction. The stretch bar 4 is pushed out of the locking configuration with the split cotter 15, the clamp is open and one or both of the tooling die halves 3 are moved apart releasing the just provided (semi)product 12 (not shown in this Figure) to be removed from the die as illustrated by hatched lines in Figure 1.

The present invention is not limited to the above described preferred and advantageous embodiments of the device. Thus e.g. the by way of examples shown locking means being a split cotter and single stretch bar can be exchanged by other locking means, such as a single (member) cotter, single fork shaped cotter and/or split stretch bar configuration or embodiment based on a bayonet locking principle.

Furthermore, the shown integral (one piece) stretch bars can be substituted by bars composed of two segments, something which will further beneficently influence the actual handling/manufacturing time without departing from the spirit of the present invention.

Claims

1. Fastening device (2) in a hydroforming apparatus comprising a pressure die (3) controlled by a cylinder system, the cylinder system comprises a cylinder house (5), piston (6), stretch bars (4) and locking means (15), characterized in that the stretch bars (4) are pre-stretched and act as a piston rod for the piston (6).
2. Device according to claim 1, characterized in that the pre-stretched bars (4) are located adjacent to the die (3) or the die cavity and where the locking means (15) is a cotter.
3. Device according to claim 1 or 2, characterized in that applied cylinders operate with a short stroke length from 2 to 10 mm.

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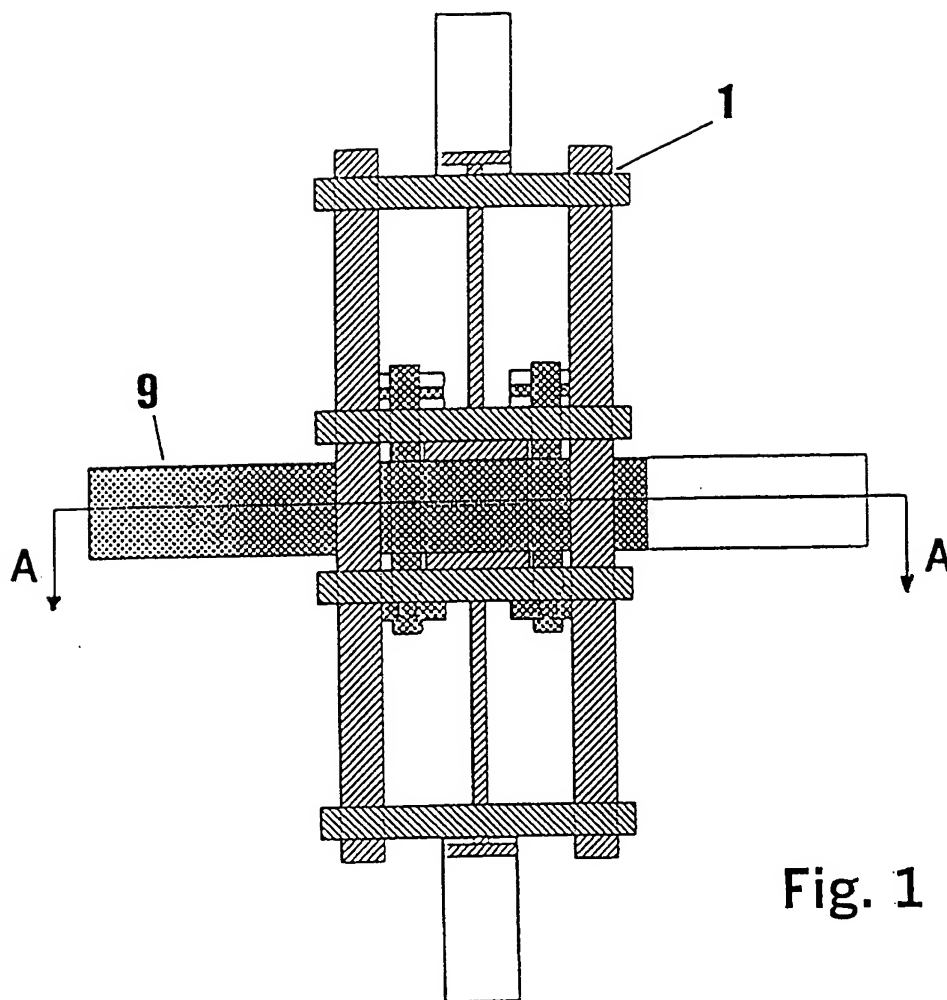


Fig. 1

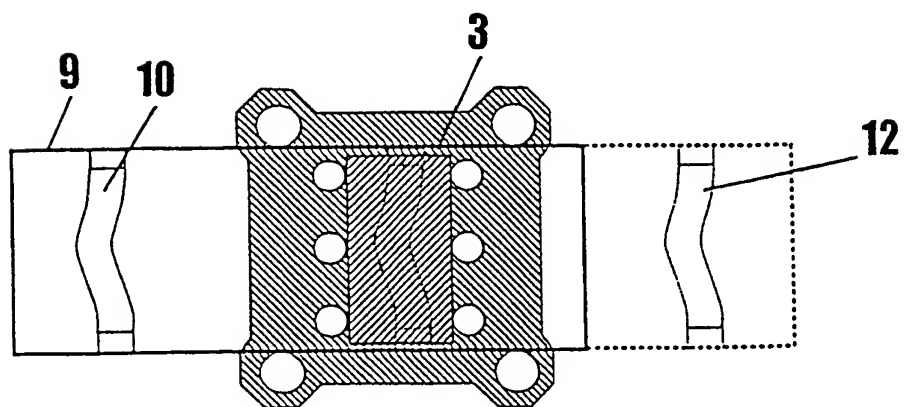


Fig 1a

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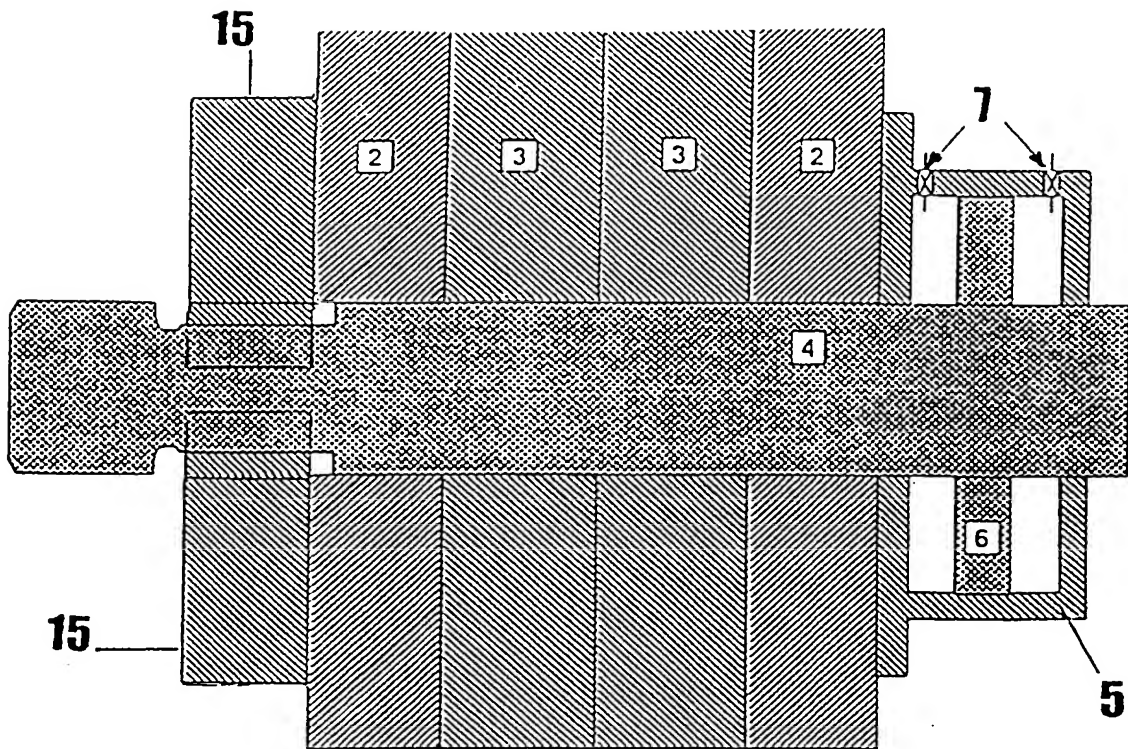


Fig. 2

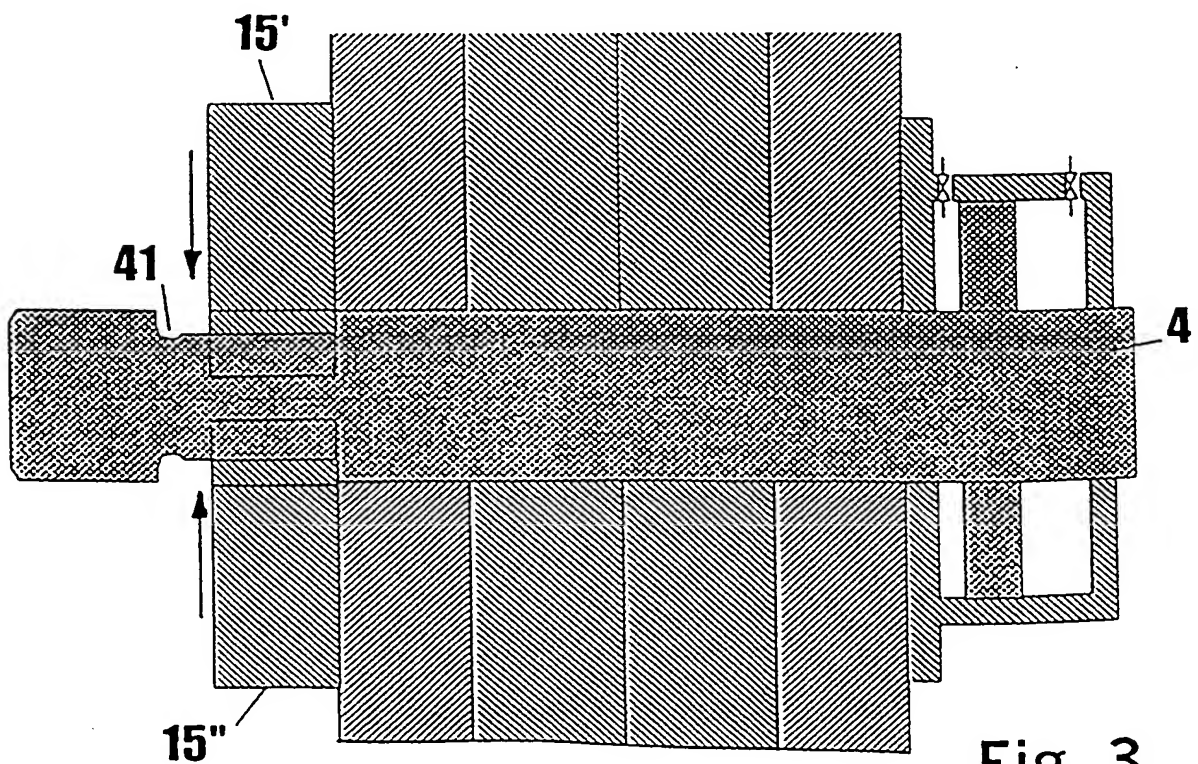


Fig. 3

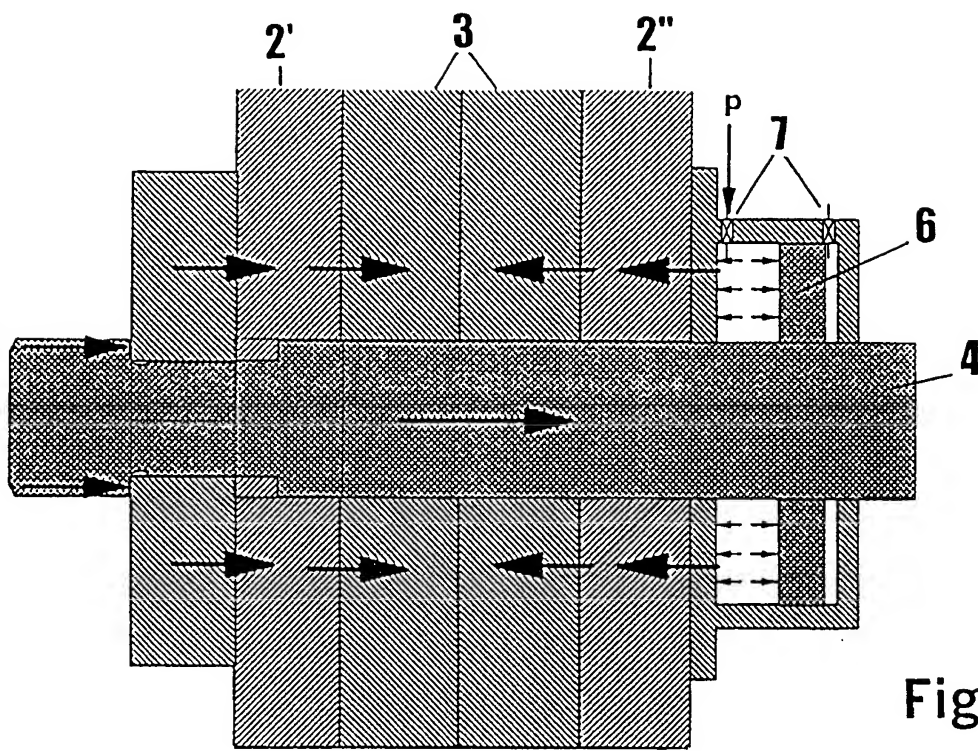


Fig. 4

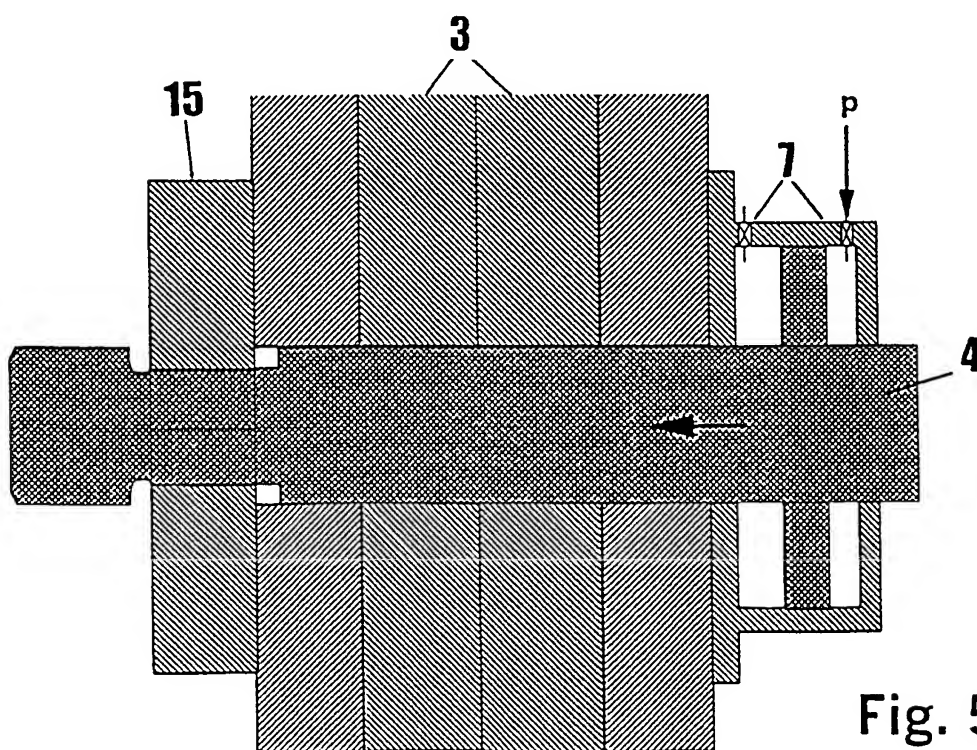


Fig. 5

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 00/00102

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B21D 26/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
D,A	EP 0865845 A1 (WDB RINGWALZTECHNIK GMBH), 23 Sept 1998 (23.09.98), figure 1 --	1-3
A	DE 19705244 A1 (HUBER & BAUER GMBH), 13 August 1998 (13.08.98), abstract --	1-3
A	DE 19614243 C1 (MERCEDES-BENZ AKTIENGESELLSCHAFT), 24 July 1997 (24.07.97), figure 2, abstract --	1-3
A	DE 19711162 A1 (KLEINER, MATTHIAS), 24 Sept 1998 (24.09.98), claims 1-12 -----	1-3

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

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International application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0865845 A1	23/09/98	DE 19712128 A	24/09/98
DE 19705244 A1	13/08/98	EP 0858848 A	19/08/98
DE 19614243 C1	24/07/97	NONE	
DE 19711162 A1	24/09/98	NONE	

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